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A. D. MELVIN, CHIEF OF BUREAU.

METHODS OF ERADICATING CATTLE TICKS.

BY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., April 26, 1907.

SIR: I have the honor to transmit herewith a manuscript entitled "Methods of Eradicating Cattle Ticks," by Dr. Louis A. Klein, and to recommend its publication as Circular No. 110 of this Bureau.

This paper represents the initiatory effort in a series of cooperative experiments undertaken by the Pathological Division of this Bureau in conjunction with the South Carolina Agricultural Experiment Station. The principal method recommended—that of oiling the cattle—is especially applicable to certain sections in the South where the land is not fenced, or where tenants, hired hands, and owners use one pasture in common.

There is a widespread interest in this subject at this time, and the demand for information concerning simple, practicable, and inexpensive methods of eradicating ticks is very great.

Very respectfully,

A. D. MELVIN,
Chief of Bureau.

HON. JAMES WILSON,
Secretary of Agriculture.

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METHODS OF ERADICATING CATTLE TICKS.

The eradication of the cattle tick (*Boophilus annulatus*) is a subject well worth the attention of every cattle owner and of every person interested in the development of the live-stock industry in the South and the maintenance of the productiveness of the soil. To prove this, it is only necessary to mention some of the injuries and losses resulting from the presence of this parasite.

REASONS FOR ERADICATING TICKS.

TICKS ARE SOLE TRANSMITTERS OF TEXAS FEVER.

Cattle ticks transmit the disease of cattle known as Texas fever, splenetic fever, distemper, big gall, bloody murrain, red water, tick fever, acclimation fever, etc. When calves and young cattle are infested with cattle ticks, they do not show any visible symptoms of the disease, but if their temperature is taken with a thermometer and their blood examined it is very evident that they are passing through a mild attack. This mild form of the disease, to which all calves born in tick-infested premises are exposed and from which they nearly always recover, endows them with a natural resistance or immunity to the disease, and when such animals are exposed to infestation with cattle ticks in later life, even if they have been free from ticks for some time, they do not suffer from the disease if they are in normal health and condition at the time of exposure. This is the reason that the cattle in sections where ticks are common may be seen heavily infested with ticks and yet in good health. On the other hand, animals that are born on tick-free premises are attacked by the disease if exposed to ticks later in life. Those under 18 months old at the time of the first infestation with ticks may recover, but with the mature cattle the disease is usually fatal.

Previous to the passage of the stock law in South Carolina all cattle ran at large and all were exposed to ticks as calves and acquired an immunity to the disease. Consequently little or nothing was heard of Texas fever among native cattle. But since the stock law went into effect many of the pastures have become free from ticks for various reasons which are well understood by those familiar with the life habits of the cattle tick, and cattle raised in such pastures do not acquire

an immunity to the disease, so that when they are removed to other pastures where they become infested with cattle ticks they contract the disease as readily as cattle shipped in from the North.

RESTRICTION OF SOUTHERN CATTLE TRADE.

Territory in which cattle are infested with the Texas fever tick is placed below the Texas fever quarantine line maintained by the United States Department of Agriculture. This quarantine line, which extends entirely across the country, runs in a southwesterly direction through North Carolina and strikes the north line of South Carolina at the northeastern corner of York County, whence it extends westerly along the north line of the State to Chattooga River, and thence southerly along the western border of the State to a point opposite the south-

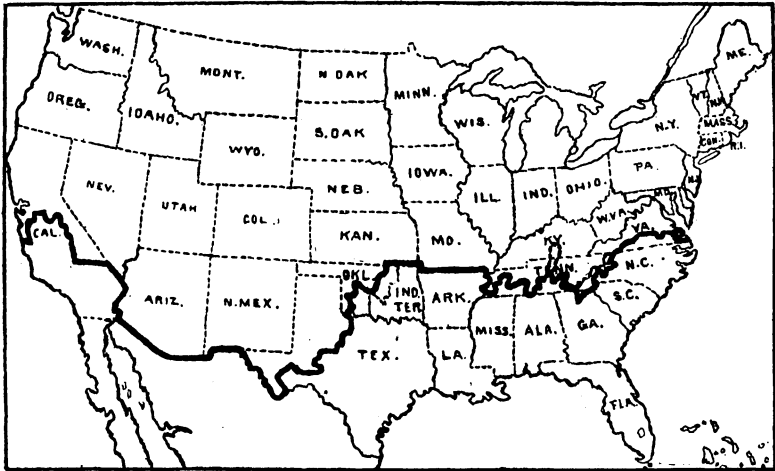


FIG. 1.—The Texas fever quarantine line. All cattle in the territory below the heavy black line are in quarantine because this area is infested with cattle ticks.

eastern corner of Stephens County, Ga., whence it extends westward. (See fig. 1.) It will be seen that South Carolina is wholly below the quarantine line and is therefore subject to the quarantine regulations enforced by the United States Department of Agriculture. During the greater part of the year no cattle can be driven from this State to any point in Georgia or North Carolina above the quarantine line, and they can not be transported by rail to any point above the quarantine line in these or other States, except to public stock yards where certain pens are set aside for the exclusive use of tick-infested cattle, and they can not be taken out of these pens for any purpose except to be removed to a slaughterhouse and butchered. The markets for cattle north of the quarantine line are therefore only accessible to fat cattle ready for slaughter. There is a demand at all these markets for young cattle in a thrifty, growing condition, but not fat, from farmers who

desire to take them home and fatten them on their grain and hay crops; and thousands of such cattle are sold annually, but the man in the infected district who can produce this class of cattle economically is barred from this trade because the ticks with which his cattle are infested would spread Texas fever in their wake if they should be taken out into the country. For the same reason thoroughbred stock suitable for breeding or dairy purposes can not be sold to go to any point above the quarantine line.

DAMAGE TO CATTLE BY LOSS OF BLOOD AND IRRITATION.

Cattle ticks live and grow upon the blood which they suck from the animal to which they are attached. A few ticks may remain upon immune cattle continuously and produce no apparent effect, but when they become more numerous, enough feed must be given to maintain the ticks as well as the cattle, or the latter will become weak and impoverished. Sometimes this will occur in spite of good feeding, because the animals are not able to digest and assimilate enough food to meet the demands of the ticks and their own bodies for blood. In biting into the skin to connect their sucking organs with the blood supply the ticks set up little areas of inflammation, and when the parasites are numerous the irritation thus produced is a cause of considerable worry. Young animals exposed to excessive tick infestation become stunted, weak, and more liable to succumb to disease; dairy cows give a reduced yield of milk, and beef cattle can only be fattened, if at all, at increased cost.

BAR TO IMPROVEMENT OF BREEDING STOCK, ETC.

Improvement of the native cattle is seriously retarded because, unless the animals are brought in early and subjected to the inoculation process, the introduction of new blood is limited to animals from tick-infested territory.

Other losses and injuries resulting from cattle ticks could be mentioned, but those above stated will serve for our present purpose.

THE PRACTICABILITY OF TICK ERADICATION.

Viewed in the abstract, the eradication of the cattle tick appears as a problem involving the destruction of millions of ticks upon thousands of cattle and in hundreds of pastures, but when we are informed as to the life history of the cattle tick and see how this knowledge of its life habits and needs can be made use of to its own destruction, and in what a wholesale manner this destruction can be accomplished by practicable methods, the work appears less stupendous. That tick eradication is not only possible, but practicable has been demonstrated, not only in the State of South Carolina, but also in the neighboring

States of North Carolina and Georgia, where several counties have been freed from cattle ticks and, in consequence, released from quarantine restrictions.

LIFE HISTORY OF THE CATTLE TICK.

As the various methods for eradicating cattle ticks are all based on the life history of the tick, a brief outline of its habits will be here given. The large ticks, one-third to one-half inch in length, seen upon cattle are the maturing females. When a female tick reaches maturity she loosens her hold on the skin of the animal and drops to the ground, where, in four to eight days in summer to two weeks or longer in the fall, she deposits from 1,500 to 3,000 eggs, and then shrivels up and dies. (See fig. 2.) Larval or seed ticks are hatched from the light-brown or waxy-looking eggs in thirteen days to six weeks in the warm seasons of the year, the period depending on the temperature, moisture, soil, etc. Eggs deposited late in the fall, however, will not hatch until the following spring. These larval or seed ticks are very small when hatched, being one thirty-second of an inch in size, but they are very active and crawl upon grass blades, weeds, shrubs, and fence posts, where they collect in large numbers and await an opportunity to attach themselves to a host. The larval ticks can not develop beyond this stage, in which they have six legs, until they become attached to cattle, or to horses and mules, and if they do not become established upon one of these animals within three or four months after they are hatched they will perish. When the opportunity is afforded, the larval ticks crawl up the legs of cattle and attach themselves to the skin covering the inside of the thighs, escutcheon, inside of the flanks, and other parts of the body, and immediately begin sucking blood. At the end of a week the seed ticks molt, or cast off their outer covering, and appear with an additional pair of legs. At the end of another week a second molt occurs, from which the ticks emerge with sexual organs complete. The males and females are about the same size at this period, but after fertilization, which takes place shortly after the second molt, the females rapidly enlarge, and in one to three weeks after the second molt in summer, and in four weeks or more in fall and winter, the females become mature and drop to the ground and deposit eggs, from which a new crop of seed ticks is hatched.

CONCLUSIONS BASED ON THE LIFE HISTORY OF THE TICK.

From the foregoing it will be seen that—

1. If cattle, horses, or mules are placed in a tick-infested pasture the seed ticks will attach themselves to these animals and grow.
2. If cattle, horses, and mules are kept out of a tick-infested pasture the seed ticks will perish of starvation within three or four

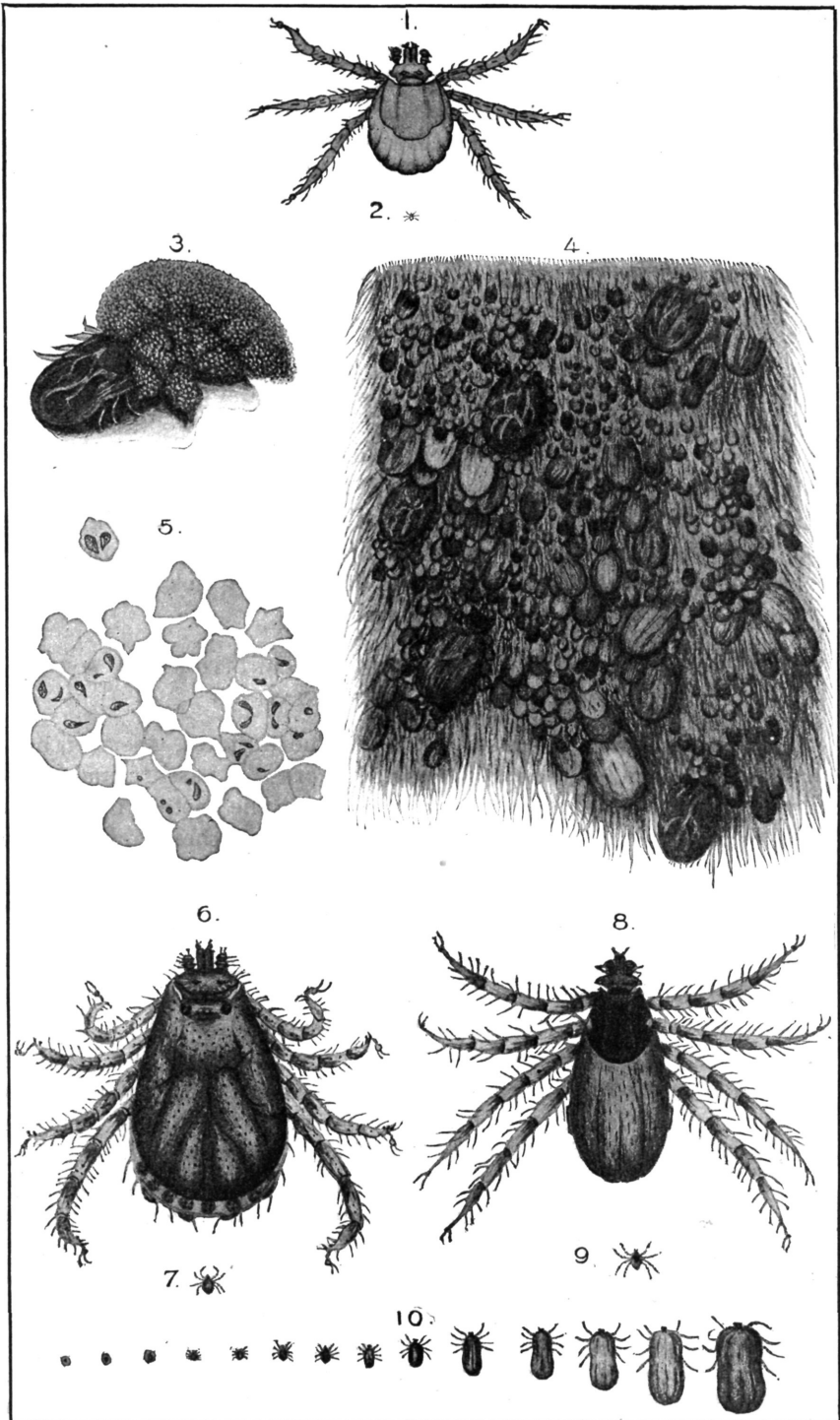


FIG. 2.—Cattle ticks and the Texas fever protozoa which they transmit to cattle: 1, larva of cattle tick ($\times 25$); 2, same (natural size); 3, mature female and eggs ($\times 2$); 4, hide showing cattle ticks (natural size); 5, blood cells containing Texas fever protozoa ($\times 1,000$); 6, male cattle tick ($\times 15$); 7, same (natural size); 8, young female cattle tick ($\times 15$); 9, same (natural size); 10, various stages of cattle ticks (natural size).

months after they are hatched. They will not attach themselves to other animals; the ticks usually found on dogs, rabbits, etc., are not cattle ticks, but belong to other species.

3. The time required for the female ticks to deposit eggs and for the eggs to hatch is rarely less than three weeks, and may extend over six or eight weeks, and eggs deposited late in the fall may not hatch until the following spring.

4. In the warmer seasons of the year, twenty to forty days after becoming attached to cattle the female ticks become mature, drop to the ground, and deposit eggs.

5. Each female tick destroyed will cut off succeeding generations of millions of seed ticks.

These facts, which are the result of long and patient study by numerous investigators, must all be taken into consideration in formulating any rational method of tick eradication. We have also to consider the local condition existing on the particular farm or plantation where the work is to be done, for, as will be plainly evident, a method that could be used on one place might be entirely impracticable on another. Fortunately, the life habits of the cattle tick are such as to render it vulnerable to attack in several ways.

METHODS OF ERADICATION ADAPTED TO CONDITIONS IN SOUTH CAROLINA AND OTHER STATES.

In South Carolina, as in many other Southern States, where on most plantations no land is fenced except a few acres for pasture, and where in many places tenants and hired hands use the pasture in common with the landowner for their milch cows, driving these cows to their individual lots and barns at night and back to the pasture in the morning, the conditions demanded a method of tick eradication that could be applied without making any change in the pasturing, feeding, or milking of the cows, and it was determined to endeavor to formulate such a method, if possible. Texas crude petroleum of a certain grade, having up to this time given the best and most certain results in destroying ticks on cattle when used in the form of a dip or bath, and it having been demonstrated in one case that cattle treated in this manner could remain on tick-infested ground for twenty-one days without becoming reinfested, it was decided to try the effect of applying this substance to the cattle by hand while they continued to use the tick-infested lots, barns, and pastures in the usual manner, and to determine the best time to begin the applications and how often and at what intervals it would be necessary to reapply the oil in order to free the cattle and premises from ticks.

To obtain information on these various points it was arranged for the South Carolina Agricultural Experiment Station, in cooperation with the Pathological Division of the United States Bureau of Animal

Industry, to carry out a series of experiments on a number of plantations in Oconee County, S. C., beginning in the fall of 1905 and continuing until the spring of 1907.

In one series of experiments the first application of the oil was to be made in the fall, at the time the last crop of ticks of the year was maturing on the cattle, and the oil was to be applied again in the spring as soon as ticks appeared on the cattle. From the life history of the tick it seemed a reasonable conclusion that nearly all the ticks could be disposed of in these two applications. The first application in the fall would dispose of the ticks on the cattle that would otherwise deposit most of the eggs that would hold over during the winter and contribute most largely to the first crop of ticks in the spring, while the seed ticks on the ground at this time would be kept off the cattle until the weather became cold enough to render them immovable or to kill them. The application in the spring would dispose of the seed ticks hatched from the eggs laid by the ticks dropped from the cattle immediately before the oil was applied in the fall. As there was no certainty that the winter temperature would fall low enough to kill these seed ticks and as there was a probability that they would become active enough to attach themselves to the cattle, or that the eggs on the ground might be hatched during a prolonged period of mild weather, the cattle were to be kept under observation during the winter and the oil applied should ticks appear on them. They were also to be kept under observation after the first application in the spring, because it was too much to expect that all the seed ticks on the ground would attach themselves to the cattle at the same time and be killed by the one application.

In another series of experiments the first application was to be made in the spring as soon as the first crop of ticks appeared on the cattle, to determine whether or not the application of oil in the fall had any effect in reducing the number of applications necessary in the spring. Circumstances over which we had no control prevented these plans from being carried out in all cases as arranged, and the amount of exact information expected was not obtained; nevertheless, the experiments demonstrated beyond any doubt that it is possible to eradicate ticks by applications of Texas crude oil while the cattle continue to use the infested barns, lots, and pastures.

The methods which have operated successfully in these experiments, and which can be expected to work with equal success in the other cases, are as follows:

OILING CATTLE.

About October 15 give all cattle on the place a thorough application of crude oil. Then examine the cattle closely at least once every week, and when ticks are found on any of them apply the oil again to all of them. Unless the winter is mild it will probably not be necessary to

make the second application of oil until some time in March. After the second application the cattle should be kept under observation as before, and the oil reapplied to all the cattle as soon as ticks are discovered on any of them. A third application will very likely be necessary about four weeks after the second, and after this, in most instances, no ticks will be seen.

If for any reason it is more convenient, the work can be begun in the spring without any disadvantage. If the first application is made when the first crop of ticks appears on the cattle, and before any have had an opportunity to drop off, the ticks will in most cases be eradicated after the third application, provided none are allowed to mature on the cattle and drop off between the applications. The second application will usually be required about four weeks after the first, and the third about three weeks after the second. Had it been possible to carry out the experiments as planned, these periods could be given with greater accuracy.

The oil is easily applied to cattle that are at all gentle by tying them to a post or tree with a rope and rubbing the oil on both sides at the same time. When the oil is applied to both sides simultaneously the animal submits to the process much more quietly than when it is applied to one side at a time. Nothing will serve better for applying the oil than a piece of burlap about a foot and a half square—the material of which bran, fertilizer, and oat sacks are usually made. If many cattle are to be oiled, it will save considerable time to have two buckets to hold oil, one for each side of the animal.

The oil must be applied all over the animal and rubbed in against the hair, so that the skin as well as the hair will be thoroughly covered with it. It must be put on like paint on a house—every spot covered. This is very important, because on this and the prompt discovery of ticks the success of the work entirely depends. The ordinary farm hand can not be trusted to do this work without supervision, as he is almost certain not to apply the oil thoroughly. The region between the fore leg and the brisket, the inner side of the flank, the internal surface of the ears, the depression at either side of the root of the tail, and the end of the tail are, according to observation, especially liable to be neglected. Two men can properly oil five or six cattle an hour, and about three-quarters of a gallon of oil will be required for each animal.

None of the animals treated in our experiments suffered any injurious effects from the oil, although in some cases applications were made in the hottest part of the summer. In hot weather, for the first day or two after the oil was applied, the cattle usually showed a disposition to keep in the shade of the timber during the day, and did most of their grazing after sundown. If there is no timber in the pasture, some means should be provided to afford protection from

the sun when the oil is used in hot weather. Milch cows treated with the oil, when properly milked, suffered only a slight and temporary decrease in the milk yield, such as might be expected when a cow is subjected to any unusual conditions. The odor of the oil was not transmitted to the milk in the case of any of the cows in the experiments, but it so happened that the cows were milked in the open air.

The oil used in these experiments was a certain grade of Texas crude petroleum. In barrel lots it costs 6 cents a gallon at Port Arthur, Tex., and the freight charges to South Carolina points are 10 to 11 cents a gallon, making the total cost 17 cents a gallon. Larger quantities can be purchased at a lower rate.

In the fall of 1906 the veterinary inspectors of the Bureau of Animal Industry engaged in tick eradication work used quite extensively a crude oil obtained from wells in West Virginia and Kentucky, and the results were equally as good as with the Texas crude oil. This oil is known to the trade as West Virginia black oil; it can be purchased from oil dealers in South Carolina at 17 cents a gallon.

Satisfactory results have also been obtained with a 20 per cent emulsion of oil forced into the hair of the cattle with a spray pump.^a The emulsion is easily made, either with the West Virginia or the Texas oil. Dissolve one-half pound of laundry soap in one-half gallon of soft water by heating the mixture, and to this solution add 2 gallons of crude oil and mix thoroughly with the spray pump or by stirring vigorously. Immediately before using dilute with $7\frac{1}{2}$ gallons of water.

When these oils can not be obtained a fairly good substitute can be made with 1 gallon of crude cotton-seed oil, one-half gallon of kerosene, and 1 pound flowers of sulphur. Heat the cotton-seed oil and stir in the flowers of sulphur until the latter is dissolved, and when the mixture is cool add the kerosene. It will be necessary to apply this mixture more frequently than the crude oil.

CHANGING PASTURES AND LOTS.

A most satisfactory method of eradicating ticks is one arranged by Mohler,^b in which part of the pasture is vacant for five months at a time to starve out the ticks, and in which the cattle are freed from ticks by being kept for three successive periods of twenty days each in three lots or fields. The infested pasture is divided by a double line of fence into two portions, the two lines of fence being placed 10 feet apart. (See Fig. 3.) The cattle are removed from one portion (lot No. 1) and placed in the other portions of the pasture (lot No. 2) on June 1. They are kept in lot No. 2 until September 10, when they are to be passed through a series of three lots located on cultivated fields that have not been used by cattle for at least nine months previ-

^a Bulletin 97, Bureau of Animal Industry, p. 73.

^b Bulletin 78, Bureau of Animal Industry, pp. 36-38.

ous, remaining twenty days in each of these lots. On November 10, the end of the twenty-day period in the last lot, they are placed in lot No. 1, where they remain until the following May, when the fence dividing the pasture can be taken down. The cattle having been out of lot No. 1 from June 1 to November 10, and out of lot No. 2 from September 10 until the following May, the ticks will be starved out. Horses and mules must also be kept out of the two parts of the pasture during these periods, as the cattle ticks may attach themselves to these animals.

The cattle not having remained in any of the three lots on the cultivated field for more than twenty days in succession, it was not possible for the ticks that dropped from them to produce eggs and the eggs to hatch young ticks to reinfest them. While the cattle are in these lots the ticks which are on them when they are placed in the first of the

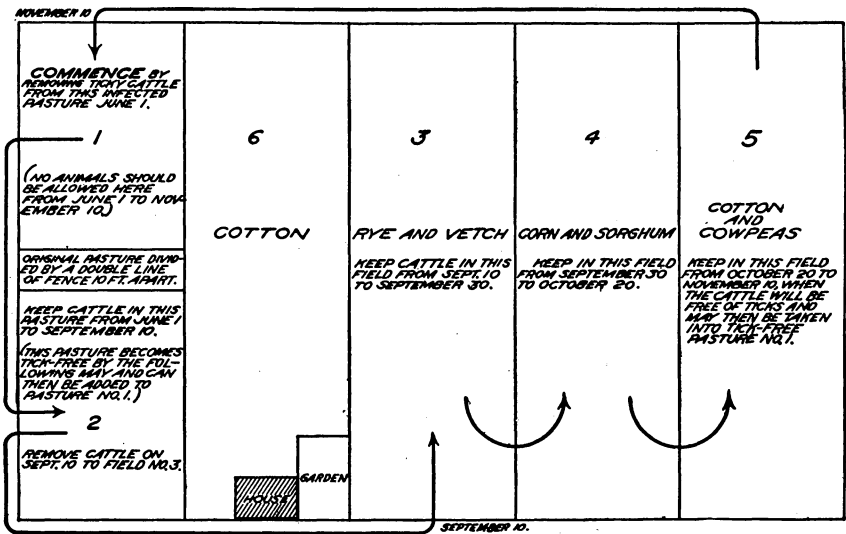


FIG. 3.—Cleaning cattle and soil by pasture rotation.

three lots are maturing and dropping off, and no opportunity is given for young ticks to reinfest them, consequently the cattle eventually become free from ticks. Sometimes this occurs at the end of the period in the second lot, and sometimes a few days later; but the cattle must be kept in the third lot until November 10, even though they are clean before that time, because they can not safely be put back into the first part of the pasture (lot No. 1) before that date. This method has been tested in Oconee County, S. C., and the dates here given were found to be suitable for this climate. In the first test the cattle were entirely free from ticks at the end of the period in the second lot, forty days. In the second test a few ticks were found at this time, but the cattle were entirely free a week later.

The fence dividing the pasture must be so located that the surface drainage will be from lot No. 1 into lot No. 2, and the lots should be so located that any stream of water running through them will flow from lot No. 1 into lot No. 2. A board should be placed close to the ground at the bottom of each fence, or in place of this a furrow can be plowed on each side of the fence, the soil being turned toward the fence. The fences dividing the three lots in the cultivated field must be arranged on the same principle, but the surface drainage must be in the opposite direction, that is, from the third lot to the second, and from the second to the first. In moving the cattle from the different parts of the pasture through the different lots and back to the pasture they must not pass over the same ground, and the ground that they pass over before they are freed from ticks must be so located that it will not drain into any of the lots or onto the ground which they are to be driven over after they are freed from ticks.

In carrying out this plan no animals need be taken into consideration except cattle, horses, and mules. It is true that ticks are frequently found on dogs, and on rabbits, and other wild animals, but these are different species of ticks from the cattle tick, so that even if these animals do frequent the pastures and lots this will not interfere with the successful operation of the method if the plan is carried out as above outlined.

THE "STARVATION" PLAN.

Another method, which has been used with great success by Butler in North Carolina, is to remove all cattle, horses, and mules from the pasture on September 10 and keep them out until April 10 or May 1. The ticks in the pasture, being thus deprived of animals upon which to feed for a longer time than they can live without food, will perish from starvation. The cattle can be freed from ticks by any of the methods previously described or which are given below, and the ticks will then be entirely eradicated. By this method the pasture is thrown out of use during a period of the year when it is of the least value for grazing. The only part of this period when there is grass for grazing is from September 10 to about the latter part of October, and forage crops, such as cowpeas, sorghum, rye, etc., to take the place of the grass during this time, as well as during the remainder of the period, can be readily provided. Another advantage of this method is that it can be carried out when regular farm work requires the least attention.

PICKING OR BRUSHING OFF THE TICKS.

Where there are only one or two milch cows, or even in a dairy herd where the cattle are stabled twice a day, a very simple and effective although somewhat laborious method is to remove the ticks with the fingers or with a stiff brush or a currycomb. If the cattle are carefully looked over three times a week all adult females will be discovered

and removed before they mature and drop off to lay eggs, and when the cow has collected all the seed ticks on the premises and brought them to the barn to be disposed of in this way, the ticks will be eradicated. Ticks removed from the cattle are, of course, to be destroyed by crushing or burning. If this method is persisted in for a sufficient time the ticks will be eradicated from the premises. The best time to begin with this plan is when the ticks first appear in the spring; another good time to begin is September 1, but the method can be put into operation at any time.

TYING OUT OR STAKING.

Cattle which are accustomed to being tied can be staked out on the cultivated fields in such a manner that they will not occupy or pass over the same ground more than twenty days at a time. The movement of the cattle should be so arranged that there will be no surface drainage from the ground which they have occupied to that which they are using or are to use in the future. By this method the cattle will be freed from ticks in forty to sixty days, provided they do not become reinfested in the place or its surroundings where they are taken to be milked or where they are kept overnight. This reinfection can be avoided by cleaning and disinfecting such places every twenty days. The ground should be scraped clean of all litter and then sprinkled or sprayed thoroughly with a solution consisting of 1 part of carbolic acid to 20 parts of water or $1\frac{1}{2}$ pounds of lime and one-quarter of a pound of carbolic acid to each gallon of water. The fences, walls of buildings, etc., should also be disinfected in the same way, and litter scraped from the ground should be saturated with the disinfecting solution or burned.

FEEDING SULPHUR NOT EFFICACIOUS.

It is a very general belief in all sections where cattle are infested with ticks that the administration of sulphur internally will keep cattle free from ticks, but in experiments carefully carried out by the Bureau of Animal Industry and other investigators cattle receiving sulphur became infested with ticks as readily as other cattle kept under exactly the same conditions except that they did not receive any of the drug. The writer has also frequently found infested cattle which had been given sulphur for some time to free them from ticks. There does not seem to be any basis in fact for this belief, and the results will be disappointing where sulphur is depended upon to eradicate ticks.

[Cir. 110]